1215480

PATENT SPECIFICATION (11) 1215480

DRAWINGS ATTACHED

(21) Application No. 59214/67 (22) Filed 29 Dec. 1967

(31) Convention Application No. 605668 (32) Filed 27 Dec. 1966 in

(33) United States of America (US)

(45) Complete Specification published 9 Dec. 1970

(51) International Classification H 01 j 61/26

(52) Index at acceptance

H1D 12B1 12B13Y 12B47Y 12B8 12G 18C 18D 35 5A 5P3 9B 9H 9Y

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(54) ELECTRIC DISCHARGE DEVICE

(71) We, SYLVANIA ELECTRIC PRODUCTS, INC., a corporation organized and existing under the laws of the State of Delaware, United States of America, of 100 West 10th Street, Willmington, Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to electric discharge devices and particularly to high pressure devices employing fills of mercury, or mercury and halogens. Such devices generally include a quartz arc tube which contains the fill and is supported upon a wire frame which is disposed within an outer bulbous envelope.

High pressure electric discharge devices containing mercury, and also those containing mercury and halogens, are known. It has been recognized that hydrogen, which can be a contaminant in these devices, is detrimental to their operation. When trapped within the bulbous envelope, the hydrogen diffuses through the quartz wall of the arc tube and adversely affects starting voltages. The hydrogen migrates into the arc tube and forms, in the case of iodine fills, hydrogen iodide, which is a volatile iodine-containing species and exists as a gas at temperatures even as low as −20°F. At low ambient temperatures, the effect of hydrogen contamination is especially noticeable because the presence of the corresponding iodide produces high starting voltages. Moreover the presence of hydrogen iodide in the arc tube results in a high value of voltage required to re-ignite the lamp each half cycle of alternating current during the warm-up phase of the lamp operation. This voltage, referred to hereafter as "re-ignition voltage", is an important parameter in determining whether a lamp can operate reliably on a given ballast circuit. The lower it is, the more reliable will be operation, or conversely the more economical will be the ballast design to reach a desired level of reliability.

It has now been discovered that one of the major sources of hydrogen in such devices is the bulbous envelope itself. Ultraviolet radiation emitted from the arc tube releases hydrogen from hydoxyl radicals which are entrapped in the glass jacket.

Getters, that is materials which entrap extraneous gases, have previously been used in such devices. Gettering, as usually practised, involves flashing or volatilizing barium metal to react with gases, thereby removing them from the system. However, such procedures not only remove the hydrogen, but also getter nitrogen which is intentionally added. Since a gas should be present within the envelope, replacement of the nitrogen with argon would be required since this gas is not gettered. But because the use of argon reduces the potential where arcing between elements of the lamp can occur, it is not as satisfactory as nitrogen. Thus, the use of conventional barium getters has serious disadvantages. The same is true of the so-called flashless getters, such as zirconium, tantalum, cerium or alloys containing these metals. All of these react rapidly with nitrogen as well as hydrogen and would require replacement of the nitrogen fill gas of the outer jacket by argon.

The present invention now provides electric discharge device having a bulbous envelope containing a fill gas and having getter means containing barium peroxide for selectively removing hydrogen disposed within the bulbous envelope and having substantially no effect on the fill gas.

The gettering reaction,

$$BaO_2 + H_2 \rightarrow Ba(OH)_2$$

proceeds at reasonably rapid rates at temperatures above about 150°C. Above this temperature, the hydrogen will then be removed from the outer jacket about as fast as it is generated and diffused. Barium peroxide, on the other hand, does not react to a signi-

ficant degree with nitrogen at these temperatures.

However, if the ambient temperatures are too high, barium peroxide will decompose to yield barium oxide and oxygen, while barium hydroxide will decompose to yield barium oxide and water. But it has further been discovered that if the barium peroxide is disposed in the device at a location which is consistent with the temperature limitations set forth, these problems of competing reactions will not occur. It has been found that if the barium peroxide is located in a zone in the device where the temperature is between 150 and 427°C, that the barium peroxide will effectively getter the hydrogen and not produce the deleterious by-products, and may be used for this purpose in the presence of the outer jacket filling pressure of nitrogen, without significant reaction between barium peroxide and nitrogen.

While these temperature ranges are important, it has also been discovered that the barium peroxide should not be irradiated with ultraviolet radiation from the arc tube, since such irradiation decomposes the barium peroxide very rapidly to barium oxide and oxygen. The oxygen which is generated reacts severely with the wire frame and can also rupture molybdenum foil sections in the press seals of the arc tube.

In accordance with another aspect of the invention, a getter device comprises means for containing a charge of barium peroxide, said means including at least one foraminous plate, adapted to allow the passage of gases therethrough.

Barium peroxide is normally obtained as a very fine powder and the successful use of this material depends upon designing a container for it. It has been discovered that this container should be opaque to ultraviolet radiation although permeable to the gas in the jacket, while still preventing the powder particles from falling into the outer jacket of the device. The container may be, for example, a pair of foraminous plates, sealed at the periphery and containing the barium peroxide. The foramina may be apertures punctured in the plates or porous plates may be used.

In the accompanying drawings, which illustrate the invention by way of example:

Figure 1 is an elevational view of a high pressure electric discharge device utilizing the gettering device of the present invention.

Figure 2 is an exploded view of a getting device shown in Figure 1 and adapted to be mounted within the high pressure electric discharge device.

Referring now to Figure 1 of the drawings, the device includes a generally tubular outer bulbous envelope 1 having a bulbous central portion and a conventional base 14 attached to the bottom thereof. Extending inwardly from the base and inside of the envelope 1 is a mount 15 having a pair of stiff lead-in wires 12 and 16 in electrical conducting relation with the base 14. Disposed upon one of the stiff lead-in wires 12 is a lower U-shaped support 8 welded thereto. The U-shaped support 8 comprises a pair of vertical wires 23 and 24 rising from a horizontal base wire 25. The upper ends of the lower U-shaped support 8 are welded together with a lower strap 7 which in turn supports an arc tube 2. Preferably, the lower strap includes two sections abutting against either side of the arc tube 2 thereby holding it firmly in place and touching only the press seal of the arc tube and not the body. Generally, both sides of the lower strap 7 can be of identical construction. A pair of bumpers 26 are welded to the lower U-shaped support 8 and abut against the tubular portion of walls of the outer-bulbous envelope 1, thereby stabilizing the structure within the lamp. Preferably, these bumpers are made of a resilient material so that if the lamp is jarred, they will absorb much of the shock.

Since the lower U-shaped support 8 is electrically connected to the stiff lead-in wire 12, the support 8 forms part of the circuit in the device. Current passes from the base 14 into the lower U-shaped support 8 and thence to a lead-in wire 21 which in turn is connected to a cathode 4 in the arc tube. It is sometimes desirable to place an insulating shield about the lead-in wire 21 to prevent arcing within the lamp and between the various elements. Current passes from the lead-in wire 21 to the cathode 4 through an intermediary molybdenum foil section 6.

The other side of the circuit is formed through the stiff lead-in wire 16 which is preferably bent out of place so that parts on one side of the line are insulated from those on the other side. A resistor 13 is attached to the stiff lead-in wire associated therewith and thence to a connector 27 which in turn leads through a molybdenum foil section 6 to a starting probe 5. A bimetal 22 is disposed between the lead-in 21 and the lead-in wire 29 which is attached to the starting probe 5. The bimetal 22 is biased open when the device is turned off, but upon starting it biases closed against the lead-in wires to the probe 5, thereby establishing the same current potential at the probe 5 and the cathode 4. Such closing prevents electrolysis between the probe and cathode.

At the other end of the arc tube 2, an upper support 10 is mounted within the tubular portion of bulbous envelope 1. The support frame 10 includes a horizontal section 18 having vertical supports 17 and 19 depending downwardly therefrom and attached at the free ends to an upper strap 11 which surrounds the press seal of the arc tube 2 and rigidly holds it in place. Preferably, the

construction and disposition of the upper strap 11 is similar to that of the lower strap 7. A pair of upper bumpers 9 are mounted upon the vertical sections 17 and 19 of the upper support 10 and resiliently abut against the sides of the tubular portion of the bulbous envelope 1. Such disposition prevents breakage of the lamp if the arc tube is shaken or dropped.

A lead-in wire 28 extends to the outside of the arc tube 2 and is attached at its inner end to a molybdenum foil section 6 and thence to a cathode 3. An electrical connection is made between the stiff lead-in wire 16 and the lead-in wire 28 through a thin conducting lead 20 which may be of any suitable conducting material. Preferably, the conducting lead 20 is as far removed from the arc tube 2 as possible, generally by being bent around the perimeter of the outer bulbous envelope 1.

Disposed in an area where the ambient temperature is between 150 and 427°C is a barium peroxide-containing gettering device 34 which removes hydrogen from the space encompassed within the bulbous envelope 1. The gettering device 34 may be attached to the upper support 10 and preferably is located where it will not be in the direct path of ultraviolet radiation generated by the arc tube 2.

Referring to Figure 2, the form of gettering device shown therein includes a pressed wafer 40 of barium peroxide pellets. Each pellet is formed by placing 0.2 g. quantities of barium peroxide in a press and increasing the pressure to about 6000 p.s.i. The green compact is then fired in oxygen at atmospheric pressure at a temperature of about 300°C for 15 minutes to sinter it together. A predetermined number of pellets can then be placed in the gettering device.

The gettering device 34 shown includes a pair of outer foraminous plates 36 which are joined together at the edges by welding or crimping. Disposed inside the outer foraminous plate are a pair of inner foraminous plates 41. The foramina 38 are randomly disposed on the plates 36 and 41 and are slightly smaller than the outside diameter of the barium peroxide particles. Preferably they are sufficiently few in number that loose particles movable within the device cannot find a hole and fall out in appreciable numbers. When the plates 36 and 41 are abutted together the foramina 38 are not in alignment and ultraviolet radiation cannot penetrate appreciably. An apertured disc 42 mounted inside the plates 41 supports the barium peroxide thereagainst. As an alternative, porous or foraminous nickel or steel plates can also be used. A plate may be joined to the edge of a barium oxide containing vessel or two foraminous plates may be joined together with the barium peroxide sandwiched therebetween. The hydrogen in the envelope 1 can then freely move through the foramina 38 and react with the barium peroxide.

It has been determined that in a 1000-watt lamp no more than 3 g. of barium peroxide need be used, while in 400- and 175-watt lamps, quantities of 1 g. and 0.4 g. respectively, are the maximum necessary.

When using the gettering device, it has been found that hydrogen in the outer jacket is substantially eliminated. Re-ignition voltages of 100-watt lamps are reduced to 50V on lamps which have been aged for 1000 hours. The re-ignition voltage of the control lamp was 150V. After 1000 hours of ageing, in 175-watt lamps, re-ignition voltages are reduced from 130V (control lamp) to 30V (test lamp). Low tempearture (−20°C) starting voltage is reduced in 175-watt lamps from 225V control lamp) to 190V after 1000 hours. Moreover, the performance after 100 hours is substantially better than the zero hour or initial performance, thereby indicating that the getter has even removed hydrogen which was originally present inside the arc tube 2. This hydrogen has appreciably diffused outward through the quartz wall of the arc tube into the outer jacket where the getter could react with it.

WHAT WE CLAIM IS:—

1. An electrical discharge device having a bulbous envelope containing a fill gas and including contaminating hydrogen, and getter means containing barium peroxide for selectively gettering hydrogen from within the envelope while having substantially no effect on the fill gas.

2. A device according to Claim 1 wherein the getter means is disposed in a location in the device wherein it is subjected to temperatures between 150 and 427°C.

3. A device according to Claim 1 or 2 wherein the getter means is foraminous.

4. A device according to Claim 3 wherein the getter means comprises a pair of foraminous plates sealed to each other at the edges.

5. A device according to Claim 3 or 4 wherein the foraminous getter means is opaque to ultraviolet radiation.

6. A device according to any of the preceding claims in the form of a high pressure mercury discharge lamp having an arc tube disposed within the envelope.

7. A high pressure electric discharge device substantially as described herein with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office, by the Courier Press, Leamington Spa, 1970.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1215480 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

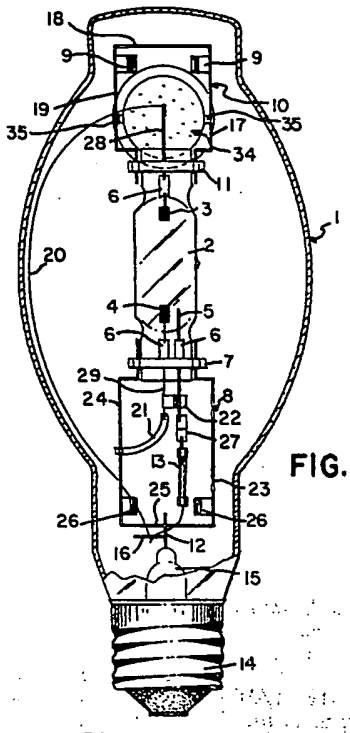

FIG.1

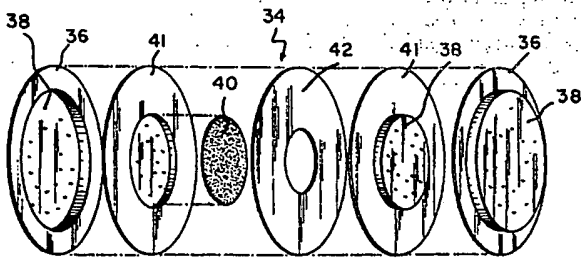

FIG.2